Syllabus

Instructors: Arnaud Trouvé
Department of Fire Protection Engineering, University of Maryland
Office: JMP 3104D / Tel: x5-8209
Email: atrouve@umd.edu / Web: http://www.fpe.umd.edu

Noah Ryder
Department of Fire Protection Engineering, University of Maryland
Office: JMP 3106 / Tel: x5-3992
Email: nryder@umd.edu / Web: http://www.dqfire.com

Class hours: MW 4:00-5:15pm, HBK 0103
Office hours: MTuWTh 9:00am-11:00am
Course duration: 15 weeks (01/23-05/9); Spring Break (03/17-24); Final Exam week (05/11-17)

TA: Zhao Zhao (milujindao@yahoo.cn)
Office hours TuTh 2:00-4:00pm

Course objectives:
This class is designed to introduce students to the basics of process safety with a focus on the methods and techniques that may be utilized when evaluating the existing or proposed safety protection solutions in industrial facilities. An emphasis is placed on properly identifying the hazards that are present, the risk exposure, and how best to address the risk. The foundation is laid by presenting the necessary background information on industrial processes and integrating this information with applicable fire/explosion safety science.

Outline:
1. Introduction to Industrial Processes & Facilities
   1.1. Energy production
       1.1.1. Mining operations
       1.1.2. Oil & gas operations
       1.1.3. Nuclear energy
   1.2. Chemical processing
   1.3. Manufacturing
   1.4. Warehousing
2. Diagramming a Facility
   2.1. Block diagrams
   2.2. Process flow diagrams (PFD's)
   2.3. Piping and instrumentation diagrams (P&ID's)
   2.4. Plot plans and discipline drawings
3. Consequence Analysis (part I)
   3.1. Overview of failure sequences
   3.2. Discharge
3.2.1. Atmospheric
3.2.2. Pressurized
3.2.3. Flashing
3.2.4. Rainout

3.3. Pool formation, spread & vaporization

3.4. Dispersion of vapors & aerosols

3.5. Ignition

3.6. Fires
   3.6.1. Pool fire
   3.6.2. Flash fire
   3.6.3. Jet fire
   3.6.4. Fireball

4. Introduction to Hazard/Risk Analysis
   4.1. Terminology
   4.2. Event scenarios
   4.3. Fire safety concepts tree
   4.4. Quantitative vs. qualitative methods
   4.5. Evaluation methodologies
      4.5.1. Checklists
      4.5.2. HAZOP
      4.5.3. FMEA
      4.5.4. What-If
      4.5.5. QRA

5. Consequence Analysis (part II)
   5.1. Explosion phenomena
      5.1.1. Physics
         5.1.1.1. Deflagrations
         5.1.1.2. Blast waves and detonations
      5.1.2. Methods for engineering calculations
         5.1.2.1. TNT equivalency
         5.1.2.2. TNO multi-energy method
         5.1.2.3. Baker-Strehlow
         5.1.2.4. CFD

6. Prevention and Detection of Fires & Explosions
   6.1. Prescriptive codes vs. performance-based design
      6.1.1. API
      6.1.2. NFPA
         6.1.2.1. NFPA 30
         6.1.2.2. NFPA 550
         6.1.2.3. NEC
      6.1.3. Energy Institute
   6.2. Prevention vs. mitigation
   6.3. Methods
      6.3.1. Inherently safe
      6.3.2. Passive protection
      6.3.3. Detection
      6.3.4. Pressure relief design
      6.3.5. Fire suppression
Course material:

- Additional journal articles, hand-outs
- Power-Point slides used in class

Course grading:

- Weekly homework assignments (40%); Mid-Term (in-class exam, 30%); Final Exam (take-home project with written report and in-class presentation, 30%).
- Rules for homework assignments:
  - Get a grade of 0 if the homework assignment is not turned back, OR if it is turned back too late (i.e., after the due date; see exception below);
  - Turning the homework assignment back late may be OK on occasions IF the instructors receive an email request (prior to the due date) AND agree to an extension; without a formal extension, the grade is 0.

Schedule:

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